

## **CLAIMS**

We claim:

1           1.       A magnetic head comprising:  
2           a read-head portion that includes one or more read insulation layers;  
3           a write-head portion that includes one or more write insulation layers; and  
4           one or more insulation layers that are optional and, if present, are disposed between  
5 the read-head portion and the write-head portion;  
6           wherein at least one insulation layer selected from one of the read insulation layers,  
7 one of the write insulation layers, or one of the optional insulation layers includes a material  
8 having a negative thermal expansion characteristic.

1           2.       The magnetic head of claim 1, wherein the negative thermal expansion  
2 material is selected from carbon fiber, carbon fiber in an epoxy matrix, carbon fiber in a  
3 photoresist matrix, zirconium tungstate ( $\text{Zr W}_2 \text{O}_8$ ), zirconium tungstate in an epoxy matrix,  
4 zirconium tungstate in a photoresist matrix, hafnium tungstate ( $\text{Hf W}_2 \text{O}_8$ ), hafnium  
5 tungstate in an epoxy matrix, or hafnium tungstate in a photoresist matrix.

1           3.       The magnetic head of claim 1, wherein the insulation layer that includes the  
2 negative thermal expansion material is selected from one or more of an undercoat insulation  
3 layer disposed between the read-head portion and a substrate, a first insulation layer within  
4 the read-head portion, a second insulation layer within the read-head portion, a write gap

5 layer within the write-head portion, a coil insulation layer within the write-head portion, or  
6 an overcoat insulation layer.

1 4. The magnetic head of claim 1, wherein the write-head portion further  
2 includes at least two layers of induction coil turns and at least one coil insulation layer  
3 disposed between the induction coil layers.

1 5. The magnetic head of claim 1, further including a heat transfer layer.

1 6. A magnetic head comprising:  
2 means for writing information to a magnetic medium, the writing means including  
3 write-head electromagnetic components;  
4 means for reading information from the magnetic medium, the reading means  
5 including read-head electromagnetic components; and  
6 means for insulating the electromagnetic components, where at least a portion of the  
7 insulating means is also means for reducing the thermal expansion of the magnetic head.

1 7. The magnetic head of claim 6, wherein the writing means further includes at  
2 least two layers of means for inducing a magnetic field, where the two layers are separated  
3 by means for insulating the inducing means that is also means for reducing the thermal  
4 expansion of the magnetic head.

1 8. The magnetic head of claim 6, further comprising:

2 an air bearing surface that includes a surface of the writing means and a surface of  
3 the reading means; and  
4 means for transferring heat away from the air bearing surface.

1 9. A disk drive for reading and writing information in a magnetic medium, the  
2 disk drive comprising:

3 a disk having a surface that includes the magnetic medium;  
4 a motor coupled to rotate the disk;  
5 a slider having an air bearing surface;  
6 an actuator configured to hold the air bearing surface of the slider proximate to the  
7 surface of the disk;

8 a magnetic head disposed within the slider and forming part of the air bearing  
9 surface, wherein the magnetic head includes:

10 i) a read-head portion that includes one or more read insulation layers;  
11 ii) a write-head portion that includes one or more write insulation layers; and  
12 iii) one or more insulation layers that are optional and, if present, are disposed  
13 between the read-head portion and the write-head portion;  
14 wherein at least one insulation layer selected from one of the read insulation layers,  
15 one of the write insulation layers, or one of the optional insulation layers includes a material  
16 having a negative thermal expansion characteristic.

1 10. The disk drive of claim 9, wherein the negative thermal expansion material is  
2 selected from is selected from carbon fiber, carbon fiber in an epoxy matrix, carbon fiber in

3 a photoresist matrix, zirconium tungstate ( $\text{Zr W}_2 \text{O}_8$ ), zirconium tungstate in an epoxy  
4 matrix, zirconium tungstate in a photoresist matrix, hafnium tungstate ( $\text{Hf W}_2 \text{O}_8$ ), hafnium  
5 tungstate in an epoxy matrix, or hafnium tungstate in a photoresist matrix.

1 11. The disk drive of claim 9, wherein the insulation layer that includes the  
2 negative thermal expansion material is selected from one or more of an undercoat insulation  
3 layer disposed between the read-head portion and a substrate, a first insulation layer within  
4 the read-head portion, a second insulation layer within the read-head portion, a write gap  
5 layer within the write-head portion, a coil insulation layer within the write-head portion, or  
6 an overcoat insulation layer.

1 12. The disk drive of claim 9, wherein the write-head portion further includes at  
2 least two layers of induction coil turns and at least one coil insulation layer disposed  
3 between the induction coil layers.

1 13. The disk drive of claim 9, wherein the magnetic head further includes a heat  
2 transfer layer.

1 14. The disk drive of claim 13, wherein the slider is further configured to  
2 dissipate heat and is thermally coupled to the heat transfer layer.

1 15. A disk drive for reading and writing information within a magnetic medium,  
2 the disk drive comprising:

3 means for holding the information in a magnetic form;  
4 means for rotating the holding means;  
5 a slider having an air bearing surface; and  
6 means for positioning the air bearing surface of the slider proximate to the holding  
7 means;  
8 wherein the slider further includes a magnetic head including:  
9 i) means for writing the information into the holding means, the writing means  
10 including write electromagnetic components;  
11 ii) means for reading the information from the holding means, the reading  
12 means including read electromagnetic components; and  
13 ii) means for insulating the read electromagnetic components and the write  
14 electromagnetic components, wherein at least a portion of the insulating means is  
15 also means for reducing the thermal protrusion of the magnetic head into the air  
16 bearing surface.

1 16. The disk drive of claim 15, wherein the writing means further includes at  
2 least two layers of means for inducing a magnetic field, where the two layers are separated  
3 by means for insulating the inducing means that is also means for reducing the thermal  
4 protrusion.

1 17. The disk drive of claim 15, further comprising means for transferring heat  
2 away from the air bearing surface.